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# Involvement of the energy-dissipating systems in modulating the energetic efficiency of respiration in mitochondria from etiolated winter wheat seedlings

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## Abstract

Effects of cyanide-resistant alternative oxidase (AOX) and modulators of plant uncoupling mitochondrial proteins (PUMP) on respiration rate and generation of transmembrane electric potential (ΔΨ) were investigated during oxidation of various substrates by isolated mitochondria from etiolated coleoptiles of winter wheat (Triticum aestivum L.). Oxidative phosphorylation in wheat mitochondria during malate and succinate oxidation was quite effective (it was characterized by high respiratory control ratio as defined by Chance, high ADP/O ratio, and rapid ATP synthesis). Nevertheless, the effectiveness of oxidative phosphorylation was substantially modulated by operation of energy-dissipating systems. The application of safranin dye revealed the partial dissipation of ΔΨ during inhibition of cytochrome-mediated malate oxidation by cyanide and antimycin A and demonstrated the operation of AOX-dependent compensatory mechanism for ΔΨ generation. The complex I of mitochondrial electron transport chain was shown to play the dominant role in ΔΨ generation and ATP synthesis during AOX functioning upon inhibition of electron transport through the cytochrome pathway. Effects of linoleic acid (PUMP activator) at physiologically low concentrations (4-10 μM) on respiration and ΔΨ generation in mitochondria were examined. The uncoupling effect of linoleic acid was shown in activation of the State 4 respiration, as well as in ΔΨ dissipation; this effect was eliminated in the presence of BSA but was insensitive to purine nucleotides. The uncoupling effect of linoleic acid was accompanied by reversible inhibition of AOX activity. The results are discussed with regard to possible physiological role of mitochondrial energy-dissipating systems in regulation of energy transduction in plant cells under stress conditions. © 2011 Pleiades Publishing, Ltd.

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## Keywords

linoleic acid, membrane potential, mitochondria, oxidation substrates, respiratory inhibitors, Triticum aestivum